Investigation

OIL RECOVERY INVESTIGATION

Background Information

Oil and gas are formed underground from the heating and compacting of rocks rich in organic matter. Once formed, oil and gas migrate to reservoir rocks. Reservoir rocks are porous and permeable, with connected open spaces that store the oil and gas and allow them to move underground.

When a drill bit first punctures a layer of rock holding oil or gas, pressure that has been sealed within the reservoir for millions of years is released. The pressure results from the force of water pushing against the oil from below, gas pushing down on the oil from above, or gas dissolved in the oil seeking to escape. If left uncontrolled, reservoir pressure can cause a hazardous, wasteful "gusher" at the wellhead on the surface.

Reservoir pressure drops as oil and gas are produced. Oil may still flow to the surface, but it does so more slowly. Sometimes the flow can be increased by using a pump. Producing a well using natural reservoir pressure or a pump is called "primary oil recovery."

"Secondary recovery" practices help restore reservoir pressure. These practices include injecting water into the formation below the oil pocket, or gas into the formation above the oil pocket.

Together, primary and secondary recovery can withdraw about one-third of the oil in a typical deposit. Tertiary, or enhanced recovery, is expensive and involves the use of chemical reactions or heat to either thin the oil so it flows more freely or to change the properties of the underground rock so the oil does not stick to it as tightly.

In this investigation you will determine the best type of reservoir for extracting oil.

Problem *(fill in problem):* _____

_____

Hypothesis

If _____ increases, then _____

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OIL RECOVERY INVESTIGATION CONT.

Materials

2 clear, wide-mouthed pint jars
250 ml of pea-sized gravel
250 ml of larger, quarter-sized gravel
2 spray bottle pumps
60 cm of plastic tubing that fits snugly over the feeder straws of the spray pumps
1 funnel
15 cm of plastic tubing that fits snugly over the small end of the funnel
2 beakers, 500 ml capacity
500 ml of cooking oil
200 ml of water
graduated cylinder
tape

Procedure

1 Attach a 30 cm length of plastic tubing to the end of the straw-like tube at the bottom of each spray pump.
2. Attach the end of the tubing about halfway down the inside of each jar and tape in place.
3. Fill the jar with pea-sized gravel.
4. Pour 250 ml of cooking oil over the gravel.
5. Holding the spray pump over the beaker, pump out as much oil from the jar and into the beaker as you can.
6. Record how much oil you recovered on the data table.
7. Attach the tubing to the bottom of the funnel.
8. Insert the tubing that is attached to the funnel all the way to the bottom of the jar of gravel.
9. Slowly add 100 ml of tap water to the jar.
10. Once again pump as much liquid as you can into the beaker. Record how much oil is floating on top of the water in the beaker.
11. Repeat steps 3-10 using the quarter-sized gravel.
12. Dispose of oil and gravel waste properly.
13. Repeat entire procedure two more times.

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OIL RECOVERY INVESTIGATION CONT.

Amount of Oil					
	Trial 1	Trial 2	Trial 3	Trial Average	Percentage
Pea-sized gravel					
At the start					100%
After first pumping					
After tap water added					
Total recovered					
Amount not recovered					
Quarter-sized gravel					
At the start					100%
After first pumping					
After tap water added					
Total recovered					
Amount not recovered					

Oil Recovery

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OIL RECOVERY INVESTIGATION CONT.

Conclusion

1. In this oil-recovery simulation, what process did the first pumping (with no water) represent?

   _____

2. Which process did the second pumping (with water) represent? _____

   _____

3. From which "well" were you able to recover the most oil? _____

4. What was the significance of changing the size of the gravel? _____

   _____

5. Does increasing the porosity of the reservoir rock increase or decrease the amount of oil that can be recovered from a well? _____

   _____

6. What problems or limitations did you find with this model? _____

   _____

Application

1. Corpus Christi, Texas, is on the coast where the subsurface is sandy. The subsurface in Midland, Texas, is limestone rock. If oil reservoirs of the same size and quality were discovered in Corpus Christi and Midland, which one do you think would yield more oil?

   _____Why? _____

   _____

Extension

1. When oil is pumped out of a well, sometimes salt water is also pumped out. The ratio of salt water to oil increases over time as the oil deposit is depleted. The amount of salt water pumped from a single well over a 10-year period can be as much as 250 million barrels. Site remediation teams are responsible for disposing of the salt water. Explain what they could do with this waste that would be environmentally safe and economically beneficial.

_____

_____

_____

Extra Credit

1. Research what site-remediation teams do. Summarize their activities here:

_____

_____

_____

_____

_____

_____